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A Review on Integrated Bluetooth Ultra Wide Band Patch Antenna

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Abstract— *Federal Communications Commission (FCC) released a bandwidth of 7.5 GHz (3.1GHz to 10.6GHz) for ultra-wide band (UWB) wireless communications. UWB is rapidly advancing as a high data rate wireless communication technology. In conventional wireless communication systems, an antenna also plays a very crucial role in UWB system. In this article Integration of Bluetooth and ultra-wideband operation in a single patch antenna is presented. Dual–band operation covering 2.4 –2.484 GHz (Bluetooth) and 3.1–10.6 GHz (UWB) frequency bands. Furthermore Bluetooth technology transfers data at low power levels while UWB technology transfers data with very high speed. When there are a large number of parameters, it becomes necessary to use optimization techniques in the design of micro strip patch antenna (MSA) to maximize its performance. The present invention relates the parameter optimization of ultra-wideband patch antenna that operate at lower edge frequency and to integrate it with a Bluetooth frequency band such using CAD FEKO software*

Index Terms — Bluetooth, Micro strip patch antenna, UWB, CAD-FEKO, MoM.

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1 Introduction

In February 14, 2002, the Federal Communication Commission (FCC) allocated a bandwidth of 7.5GHz, i.e. from 3.1GHz to 10.6 GHz to UWB applications for unlicensed use [1]. The feasible design and implementation of UWB system has become a highly competitive topic in both academy and industry communities of telecommunications due to its advantage of high date rate (more than 100 Mb/s) over short ranges, large information capacity, low cost and low power consumption, etc. The UWB antenna has an increased attention due to its impedance band-width, simple structure and Omni-directional radiation pattern. [2]

In recent years, the current trend in commercial and government communication system has been to developed low cost, minimal weight, low profile antennas that are capable of maintaining high performance over a large spectrum of frequencies. This technological trend has focused much effort into the design of Micro strip patch antennas. With simple geometry patch antennas offer many advantages not commonly exhibited in other antenna configurations. For example, they are extremely low profile, light weight, simple and inexpensive to fabricate using modern day printed circuit board technology, compatible with microwave and millimeter wave integrated circuits (MMIC), and have the ability to confirm to planar and non planar surfaces. In addition, once the shape and the operating mode of the patch are selected, designs become very versatile in terms of operating frequency, polarization, pattern and impedance. The variety in design that is possible with Micro strip antennas probably exceeds that of any other type of antenna element.

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Today Bluetooth is widely used WPAN technology. But it has several limitations like short range and low communication speed [7]. The speed of the Bluetooth technology is fairly slow by today's standards. Wi-Fi and 802.11 are developing standards that will allow that technology to reach in excess of 120 Mb/s. Today, a current Bluetooth device will go is fast as 3 Mb/s. This is appropriate for audio streaming, but not nearly enough for heavy data-oriented applications like video. Though Bluetooth devices are very slow communicators, they consume low power and provide wide range of application profiles (applications).So to have advantages of both Bluetooth and UWB, we can integrate it with UWB technology which has several advantages like high speed data transfer at low power levels, capability to handle hundreds of channels simultaneously, and no interference to existing wireless systems [4], [5].

2 Basic Concept

To have advantages of both Bluetooth and UWB, we can integrate Bluetooth with UWB. One approach is that Bluetooth technology is being developed to be a control channel that establishes application connections using its low-power association mechanisms, and then turns on and off the UWB only when a device needs to send a large amount of data.

The details of how they will work together are still being pursued. Broadly, the steps are,

1. Bluetooth establishes the connection at the physical layer.
2. Capability of a common UWB facility is discovered and reported to upper layers.
3. Both low and high speed channels are set up.

4. Service discovery in Bluetooth determines if a requested end-user function (or application) can be performed.
5. Bluetooth profiles define the applications' data paths —or alternately — a mechanism independent of application figures out best data path.
6. UWB is used as a high speed pipe, which is turned on when needed and turned off when not power-cost effective.
7. Low speed Bluetooth links maintain the connection between devices for as long as needed.

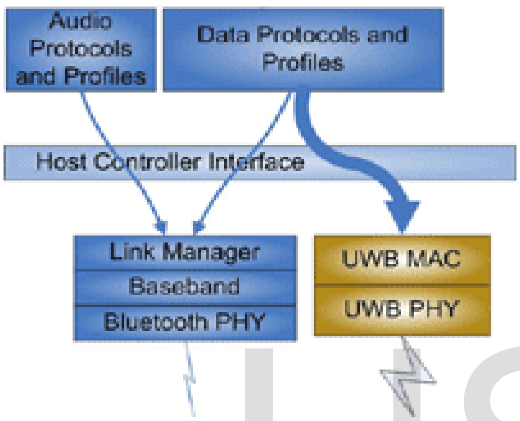

Fig.1: Data paths in Bluetooth – UWB system

Looking at the protocol stacks in Fig.1, the data paths are slightly different depending on application needs. Current audio applications, such as mobile phone headsets, do not need the speed of UWB and remain in their current technology. The data path is shown with two arrows: a thin one for low data rate applications and a thick one for the newer high-data-volume uses [4],[5]. In all cases, the packets that provide command and control information go over the Bluetooth connection.

3 Design

For the design and for the optimization of parameters we are using CAD-FEKO tool with method of moment (Mom) [6].

3.1 Method of Moment

In the method of moment, the surface currents are used to model the micro strip patch and volume polarization currents in the dielectric slab are used to model the fields in the dielectric slab. An integral equation is formulated for the unknown currents on the micro strip patches and the feed lines and their images in the ground plane. The integral equations are transformed into algebraic equations that can be easily solved using a computer. This method takes into account the fringing field outside the physical boundary of the two dimensional patch thus, providing a more exact solution. The"method of moments" starts from deriving the currents on each segment, or the strength of each moment, by using a coupling Green's function. This Green's function incorporates electrostatic coupling between the moments for if the spatial change of the currents is known accurately then one can compute the buildup of charges at points on the structure. It is usual to approximate antennas having area by wire grid approximations, which also have to be chosen extremely carefully. As one always is presented with a computed result for a simulation, even if the model is in error, one can see that replacement of areas of metal by wire grids requires physical insight into the processes involved, rather than blind application of an algorithm.

3.2 Design Steps

The design process started with the selection of the suitable shape for patch. After selection, calculations for the antenna dimensions will be carried out to determine the size of the antenna. Then, the antenna performance, that is the return loss measurement will be analyzed using CAD-FEKO SOFTWARE, if the results is not as desired modifications were made to the patch. The port location that gave the best performance to antenna would be determined using CAD-FEKO. Antennas that fulfill the desired characteristics were produced and the real return loss measurements will be carried out. If the antenna matches the requirements then the design process stops here and the antenna polar pattern will be examined. If the antenna did not fulfill the requirements then the design process will start again from the computer analysis to improve the design. FEKO is a Method of Moments (Mom) tool that can be used to calculate the radiation pattern, impedance and gain of an antenna while mounted on some defined geometry. In addition, it can calculate the isolation or mutual coupling between pairs of antennas, the near fields around an antenna and the electric currents that flow on an antenna or the surrounding structure.

The basic flow of performing a FEKO analysis consists of following steps:

1. Building geometry for the antenna (example a wire to represent the antenna) in CAD-FEKO or EDITFEKO.
2. Building a geometry to represent surrounding geometry (for instance, can model an antenna on top of an airplane or an antenna on a supporting structure which will affect the antennas performance) in CAD FEKO, EDITFEKO or an external tool.
3. Meshing the Created Antenna and Surrounding Geometries (CAD-FEKO or EDITFEKO)
4. Requesting Solution Types and Setting Solution Parameters (CAD-FEKO or EDITFEKO).
5. Running the FEKO solver (FEKO).
6. Read in and interpret results using Post FEKO.

4 Advantages

1. High speed data transfer at low power levels without interfering existing wireless systems.
2. Conformal and planar antenna structure.
3. Light weight, small size, low volume.
4. Ease of fabrication

5 Applications

1. Streaming personal video
2. Advanced wireless sound systems
3. Personal TV broadcasting
4. Wireless portable mass storage

6 Conclusion

In this review paper we presented to have advantages of both Bluetooth and UWB, we can develop an Integrated Ultra Wideband and Bluetooth Antenna which will require less power and space than existing antennas and which will transfer data at higher rates than existing antennas.

To obtain the simulation results such as VSWR, radiation pattern, impedance bandwidth, etc. for further design of UWB we are using CAD-FEKO EM simulation tool is a part of our future work.

References

[1] First Report and Order, Federal Communications Commision(FCC).

[2] Eng Gee Lim, Zhao Wang, Chi-Un Lei, Yuanzhe Wang, K.L.Man,"Ultra Wideband Antennas – Past and Present," *IAENG International Journal of Computer Science*, 37:3, IJCS_37_3_12, August 2010.

[3] Sanjeev Kumar Mishra, Rajiv Kumar Gupta, Avinash Vaidya, Jayanta Mukherjee, Member, IEEE" A Compact Dual-Band Fork-Shaped Monopole Antenna for Bluetooth and UWB Applications," *IEEE Antennas and Wireless Propagation Letters*, vol. 10, 2011.

[4] K. C. Law, s. W. Cheung, and T. I. Yuk "An Integrated UWB and Bluetooth Antenna with Dual Band-notched Characteristic," *PIERS Proceedings*, Suzhou, China, September 12-16, 2011.

[5] Shi-Wei Qu, Jia-Lin Li, and Quan Xue, *Senior Member, IEEE"*A Band-Notched Ultra Wideband Printed Monopole Antenna," *IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS*, VOL. 5, 2006.

[6] *CAD-FEKO tool- User Manual.*

[7] Specifications of Bluetooth System, Profiles, Version 1.1 [Online]. Available: http://www .bluetooth.com